

4-4 Powers of Monomials

Objective: To find powers of monomials.

Rules of Exponents	Examples
<p>Rule of Exponents for a Power of a Power</p> <p>For all positive integers m and n:</p> $(a^m)^n = a^{mn}.$ <p>To find a power of a power, you multiply the exponents.</p>	$(2^3)^4 = 2^{3 \cdot 4}$ $= 2^{12}$
<p>Rule of Exponents for a Power of a Product</p> <p>For every positive integer m:</p> $(ab)^m = a^m b^m.$ <p>To find a power of a product, you find the power of each factor and then multiply.</p>	$(-2x)^5 = (-2)^5(x)^5$ $= -32x^5$

CAUTION $(x^7)^6 = x^{7 \cdot 6} = x^{42}$ but $x^7 \cdot x^6 = x^7 + 6 = x^{13}$

Example 1 Simplify: a. $(x^2)^4$ b. $(u^3)^5$

Solution Use the rule for a power of a power.

$$\begin{array}{ll} \text{a. } (x^2)^4 = x^{2 \cdot 4} & \text{b. } (u^3)^5 = u^{3 \cdot 5} \\ = x^8 & = u^{15} \end{array}$$

Simplify.

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|--------------|--------------|-----------------|--------------|
| 1. $(a^2)^3$ | 2. $(x^4)^3$ | 3. $(t^5)^3$ | 4. $(c^3)^3$ |
| 5. $(t^2)^3$ | 6. $(x^5)^2$ | 7. $(y^{10})^3$ | 8. $(a^7)^8$ |

Example 2 Simplify: a. $(2x)^4$ b. $(-6k)^3$

Solution Use the rule for a power of a product.

$$\begin{array}{ll} \text{a. } (2x)^4 = 2^4 \cdot x^4 & \text{b. } (-6k)^3 = (-6)^3 \cdot k^3 \\ = 16x^4 & = -216k^3 \end{array}$$

Simplify.

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|---------------|---------------|------------------------|-------------------------|
| 9. $(5a)^2$ | 10. $(-6x)^2$ | 11. $(-3t)^3$ | 12. $(-4c)^2$ |
| 13. $(-5x)^3$ | 14. $(-4t)^3$ | 15. $(-2t)^4$ | 16. $(6x)^3$ |
| 17. $(5x)^4$ | 18. $(7n)^2$ | 19. $(\frac{1}{2}a)^2$ | 20. $(-\frac{1}{3}a)^3$ |

4-4 Powers of Monomials (continued)

Example 3 Evaluate if $x = 3$: a. $2x^3$ b. $(2x)^3$ c. $2^3 \cdot x^3$

Solution

$\begin{aligned} \text{a. } 2x^3 &= 2(3)^3 \\ &= 2(27) \\ &= 54 \end{aligned}$	$\begin{aligned} \text{b. } (2x)^3 &= (2 \cdot 3)^3 \\ &= 6^3 \\ &= 216 \end{aligned}$	$\begin{aligned} \text{c. } 2^3 \cdot x^3 &= 2^3 \cdot 3^3 \\ &= 8 \cdot 27 \\ &= 216 \end{aligned}$
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Evaluate if $x = 2$ and $y = 4$.

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| <p>21. a. $2x^3$
b. $(2x)^3$
c. $2^3 \cdot x^3$</p> | <p>22. a. $4y^2$
b. $(4y)^2$
c. $4^2 \cdot y^2$</p> | <p>23. a. x^2y^3
b. x^2y^2
c. $(xy)^2$</p> |
| <p>24. a. xy^3
b. $(xy)^3$
c. $x^3 \cdot y^3$</p> | <p>25. a. $3x^2$
b. $(3x)^2$
c. $3^2 \cdot x^2$</p> | <p>26. a. $5x^2$
b. $(5x)^2$
c. $5^2 \cdot x^2$</p> |
| <p>27. a. xy^2
b. $(x^2y)^2$
c. x^3y</p> | <p>28. a. $2xy$
b. $2x^2y$
c. $2xy^2$</p> | <p>29. a. $6x^2 \div x$
b. $(6x)^2 \div x$
c. $6(x^2 \div x)$</p> |

Example 4 Simplify $(-2x^2y^3)^4$.

Solution $(-2x^2y^3)^4 = (-2)^4(x^2)^4(y^3)^4$ { First use the rule for a power of a product
 $= 16x^8y^{12}$ and then use the rule for a power of a power.

Simplify.

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|--------------------------|------------------|-----------------------------|
| 30. $(3n^2)^3$ | 31. $(6b^4)^2$ | 32. $(\frac{1}{3}x^{10})^3$ |
| 33. $(\frac{1}{2}x^2)^4$ | 34. $(2ab^2)^3$ | 35. $(-3x^2y^3)^3$ |
| 36. $(4x^3y^2)^3$ | 37. $(-2xy^2)^4$ | 38. $(5m^2n^4)^2$ |

Mixed Review Exercises

Simplify.

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|--|---------------------------------------|
| 1. $(2a^2b)(3ab)(5ab^2)$ | 2. $(-xy^2)(2xy)(-3y)$ |
| 3. $(3x^2y^3)^4$ | 4. $(\frac{1}{3}t^2)(\frac{3}{4}t^3)$ |
| 5. $5c - 2a - 3c + a$ | 6. $(2x + 3y + 1) + (3x + 2y)$ |
| 7. $3 \cdot 5^2 + 3 \cdot 5$ | 8. $-3^2 \cdot 4$ |
| 9. $(3^3 + 5^2) \div 2^2$ | 10. $7 \cdot 3^2 + 6 \cdot 3 + 2$ |
| 11. $(\frac{5}{2}t^2)(\frac{1}{5}t^3)$ | 12. $(15mn^2)(\frac{1}{3}m^2)(4n)$ |